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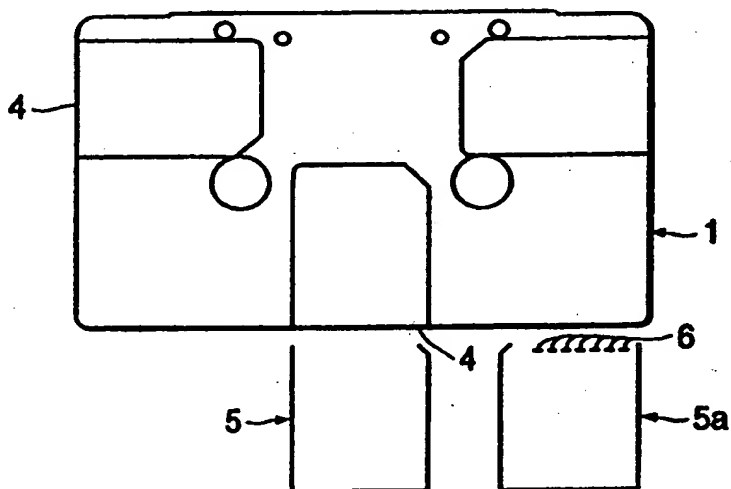
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(21) International Application Number: PCT/US99/00815 (22) International Filing Date: 13 January 1999 (13.01.99) (30) Priority Data: 09/013,036 26 January 1998 (26.01.98) US (71) Applicant: SMARTDISK CORPORATION [US/US]; 3506 Mercantile Avenue, Naples, FL 34104-3310 (US). (72) Inventors: EISELE, Raymund; Ferdinand-Abt-Strasse 1, D-65510 Idstein (DE). EISELE, Judith; Ferdinand-Abt-Strasse 1, D-65510 Idstein (DE). (74) Agents: LYNT, Christopher, H. et al.; Shanks & Herbert, TransPotomac Plaza, Suite 306, 1033 North Fairfax Street, Alexandria, VA 22314 (US).		(81) Designated States: AU, CA, JP, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published <i>With international search report.</i>

(54) Title: ADAPTER

(57) Abstract

An adapter (1) inserted into a conventional tape device interfaces the tape device (1) with one or more removable storage circuits (5, 5a) which store digital audio and/or video data.



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ADAPTER

Background Of The Invention

Field of The Invention

5 The invention relates to the field of consumer electronics, and in particular, to an adapter for use in adapting a conventional cassette tape playback/recording device with flash memory devices which store digitized audio, for example.

10 Background Information

German Patent Document DE 39 03 454 A1 discloses an element (SmartCassette) which is embodied as a cassette, is equipped with a special interface, and can be inserted into electronic data-processing devices. The interface is designed to permit a
15 transfer of data between a processor in the cassette and the data processing device via the read/write device that is provided anyway in the data processing device. A data exchange is possible between the processor of the cassette and the data-processing device without necessitating additional interfaces. Furthermore, the element is
20 equipped with a current generator, which supplies the processor and other components of the element with the necessary current, independently of an external plug connection. (See also U. S. Patent 5,159,182.)

According to U. S. Patent 3,864,743, a device having the
25 external form of a magnetic tape cassette is provided with an interface in the form of a coil. Analog signals are received by a microphone,

musical instrument or conventional magnetic-tape cassette, conducted further to the interface and transmitted via the interface to the reading head of a cassette recorder.

According to German Patent Document DE 41 35 220 C1, a
5 SmartCassette having a built-in magnetic interface, an analog/digital converter-digital/analog converter, a processor, a memory module, a current generator, a current regulator, and a battery is known. A cassette of this type can be used as a digital "magnetic tape" cassette in connection with conventional cassette players/recorders by loading
10 music that has been digitized via the interface of a loading device, e.g., a compact disc (CD) player into the processor via a digital interface, compressing the music in the processor and storing it in memory, and loading the digitized music from the memory into the processor, decompressing it there and playing it back, via the
15 digital/analog converter with an amplifier and the magnetic interface, on conventional cassette-record/playback devices with the quality that is typical of digitally-recorded music pieces.

Recently, so-called Multi-MediaCards (MMCs) have been proposed (Seimens and SanDisk Corporations). These would provide
20 small, transportable audio/video media storage in the form of a card substrate carrying a processor and/or memory, which could be inserted into a number of different media recording/playback devices adapted to receive the MMCs. The MMC memory would store, for example, digitized video and/or audio signals. Contacts on the MMC,
25 or other means, would be used to connect and transfer the digitized video/audio to a media recorder/playback device.

So-called flash memory devices have also become known and are more and more widely used, for example, in digital cameras. An MMC could use flash memory or another type of non-volatile memory.

- 5 To make use of the MMCs as proposed until now, a user would need an entirely new recording/playback device designed with a port for interconnecting with the MMCs to make use of them in their home. In other words, the existing conventional user playback/recording equipment does not interface with the MMCs.
- 10 Furthermore, additional playback equipment for use in an automobile would be required to make use of the MMCs there. As can be appreciated, this could become prohibitively expensive.

- Besides the potential; costs involved, adding a new piece of recording/playback equipment for use with MMCs may require
- 15 additional space where little exists, such as in an automobile.

Therefore, a need existed for an adapter device which could permit use of the new MMCs with the existing conventional recording/playback equipment.

- The inventors of the present invention realized that the prior
- 20 SmartCassette, described above, could be improved by providing particular adaptations for use with MMCs, and the like.

- Digital Audio Tape (DAT) recording/playback decks have recently been introduced into the audio cassette tape market. DAT provides digital quality audio on magnetic tape, with the advantages
- 25 and disadvantages inherent in a tape based device. In an automobile audio system, while more immune to vibration effects than audio CD

players, for example, tape is still an inherently fragile medium, subject to problems such as stretching, breaking, moisture build-up, and the like.

Furthermore, DAT requires relatively expensive recording and playback equipment, as compared with conventional analog audio
5 tape systems.

Summary Of The Invention

It is, therefore, a principle object of this invention to provide a
10 method and apparatus for adapting MMCs to conventional recording playback devices, such as a conventional cassette player.

It is another object of the invention to provide a method and apparatus that solves the above mentioned problems so that the purchase of additional recording/playback equipment to use MMCs is
15 unnecessary.

These and other objects of the present invention are accomplished by the method and apparatus disclosed herein.

According to an aspect of the invention, up to 6 MMCs can be inserted into sockets on an adapter according to the invention, e.g.,
20 two at the left edge of the adapter, two at the right of the adapter, and two at the rear edge of the adapter.

According to an aspect of the invention, the adapter provides sockets, an analog-to-digital/digital-to-analog (A/D-D/A) converter, a battery or batteries, at least one or more sensors, and an optional
25 digital interface and power connector, which connect to an on-board processor. The A/D-D/A converter is connected to a magnetic

transducer which provides signals to and receives signals from a magnetic read/write head of a recording/playback device, such as a conventional cassette recorder/player.

According to another aspect of the invention, the adapter
5 provides for playback of music from an MMC ROM or MMC FlashPROM.

According to another aspect of the invention, music can be recorded on the MMC FlashPROM via the magnetic transducer, or on MMC ROM via an optional digital interface, for example.

10 According to another aspect of the invention, the adapter according to an embodiment of the invention provides the capability to record onto an MMC 5a using the adapter and an ordinary analog cassette player.

According to another aspect of the invention, the adapter can
15 advantageously deliver practically digital quality audio through a conventional analog cassette player. Further, many of the severe disadvantages of conventional tape cassettes, such as stretching, breaking, loss of lubricant, scratching, becoming entangled in the player, and being erased by magnetic fields, are eliminated.

20 According to another aspect of the invention, since practically all automobiles are equipped with a cassette player as standard equipment at present, if a driver desires a higher quality sound, the expense of adding a compact disc player is no longer required, decreasing the chances that the automobile will be broken into to steal
25 such expensive equipment. With the present invention, CD quality

audio is possible in an automobile, without the risk and expense of adding a CD player to the automobile.

According an aspect of the invention, there is provided an embodiment adapted for use with digital audio tape (DAT)
5 players/recorders, yielding potentially even higher sound reproduction fidelity.

These and other aspects of the invention will become apparent from the detailed description set forth below.

10 Brief Description Of The Drawings

Fig. 1a illustrates an adapter as seen from the top according to an exemplary embodiment of the present invention.

Fig. 1b illustrates the adapter of Fig. 1 as seen from a side.

Fig. 2a illustrates the adapter of Figs. 1a-1b as seen from the
15 bottom according to an exemplary embodiment of the invention.

Fig. 2b illustrates the adapter of Figs. 1a-2a as seen from a rear edge (opposite edge nearest cassette recorder/player head).

Fig. 3 illustrates insertion of an MMC into a slot on the rear edge according to an exemplary embodiment of the invention.

20 Fig. 4 illustrates the internal parts of an adapter in block diagram form according to an exemplary embodiment of the invention.

Fig. 5 illustrates an embodiment adapted for use with a DAT player/recorder.

Detailed Description Of The Preferred Embodiments

The invention will now be described in more detail by way of example with reference to the embodiments shown in the accompanying figures. It should be kept in mind that the following described embodiments are only presented by way of example and should not be construed as limiting the inventive concept to any particular physical configuration.

With reference to Figs. 1a-1b, an adapter according to an embodiment of the invention is shown from the top. The adapter has a case 1 which houses the adapter electrical components, in the shape of a standard cassette tape housing. Battery covers 2 are provided for access to battery compartments within the housing so that batteries may be removed and inserted. Two covers 2 are illustrated as the embodiment shown utilizes two batteries. However, more or fewer batteries could be used within the spirit of the invention.

The case is designed to receive MMCs by the provision of one or more slots. In the illustrated embodiment, the case 1 includes small slots 3 on the top surface, and larger slots 4 on the respective side and rear edges. An MMC fits into a slot 4. Slots 3 allow for easy removal of an MMC with the tip of a pen, for example, which can be used to urge an inserted MMC out of a slot 4.

Fig. 2a illustrates a bottom surface of the case 1. As can be seen, slots 3 are provided in the bottom of the case 1 as well.

In the illustrated embodiment of Figs. 1a-2b, the case 1 has the shape of a standard cassette tape case, and is provided with the

necessary additional holes, ridges, etc., of a conventional cassette tape case, for receiving, for example, the cassette recorder/player drive spindles.

The illustrated embodiment is designed to accommodate up to
5 six MMCs since it is provided with six slots 4 in the case 1.
However, more or fewer slots 4 could be provided within the spirit of
the invention.

Referring now to Fig. 3, an MMC (multi-media card) as seen
from the front 5 (and back 5a) is illustrated being inserted into a slot 4
10 in the rear edge of case 1. The MMC has a plurality of mini-contacts
6 for communicating data and control signals, receiving power, and
the like.

Fig. 4 shows the internal workings of the exemplary adapter.
In each slot 4 are provided a number of contacts 16 which are
15 electrically connected to a processor 9. The end of the slot 4 thereby
forms a socket 10 for receiving and electrically connecting with
corresponding contacts on an MMC card 5a. The processor is further
connected to an A/D-D/A converter 8 and a transducer 7.

As shown in Fig. 5, the adapter is configured to be used with a
20 digital audio tape (DAT) cassette player, in that the A/D-D/A
converter 8A and transducer 7A are designed to provide a DAT
digital interface. As is known in the art, besides the fact that music is
stored on a DAT tape as digital data rather than analog signals, a
DAT cassette tape system differs from a conventional cassette system
25 in that it uses a helical scan technique to put relatively large amounts
of data on a DAT tape. In other words, the DAT player/recorder has a

rotating head which travels across the tape at an angle as the tape moves in front of it. Unlike standard audio CD ROMs, DAT tapes are both readable and writable. DAT tape decks generally use the so-called digital data service (DDS) format, as is known in the art.

- 5 Further, DAT recorders used by consumers include the serial copy management system (SCMS) which prevents wholesale digital copying of copyrighted audio recordings. Naturally, the adapter according to the present invention takes these factors into consideration in the DAT-compatible embodiment.

- 10 Returning to Fig. 4, electrical wiring interconnects the transducer 7, the A/D-D/A converter 8, the contacts 16 in the sockets 10, the processor 9, the batteries 11, an optional digital interface 12, an optional power connector 13, and one or more sensors 14. The optional digital interface 12 provides for supplying digitized audio
15 signals to one or more inserted MMCs 5a through the processor 9, for example.

- The at least one or more sensors 14 detect(s) when the conventional cassette recorder/player device into which the adapter has been placed is in fast forward or rewind by detecting the speed
20 and direction of rotation of a spindle in hole 15. The at least one or more sensors 14 signal(s) the processor 9 to switch from one prerecorded selection in an MMC 5a to another, or from one MMC 5a to another, for example.

- As can be appreciated, the A/D-D/A 8 need only be a D/A
25 device if only playing back digitally recorded audio on a conventional analog cassette player is contemplated. That is, if recording from an

analog cassette device is not required, then the A/D part of the converter 8 is not needed.

However, it could be advantageous to provide the capability to record onto an MMC 5a using the adapter and an ordinary analog cassette player, since these are currently widely used. With this embodiment, a user can place an MMC in the adapter, place the adapter in a standard cassette recorder/player, and record audio signals onto the MMC. Since the audio signals are sampled and digitized by A/D converter 8 before being stored in the MMC, some degradation of fidelity may be inherent as compared with storing digital signals from a digital audio source, such as a commercially produced compact disc (CD) directly to the MMC. The latter are generally produced professionally with expensive equipment to provide high fidelity.

The optional digital interface 12 provides a means to record digitized audio onto an inserted MMC without first having to convert from analog to digital signals in converter 8, and therefore, provides less degradation of fidelity. The processor 9 receives the digitized audio from the interface 12 and stores it to an MMC 5a inserted in the adapter. If necessary, the processor 9 can provide for compression of the digitized audio to save space in the MMC memory. Since digital music may conventionally contain approximately 5 megabytes of data per minute, before error correction and supplementary information (track information, for example), some compression may be necessary, depending on the capacity of the MMCs being used. However, the compression could already be inherent in the digitized

signals provided by the audio source device. After compression, typically there would be about one megabyte of data per minute of music, for example.

For playback, the processor 9 decompresses the digitized
5 signals read from MMC memory, and feeds the D/A part of converter 8, which in turn feeds analog electrical signals to transducer 7 to be picked up by a cassette player head.

As can be appreciated, the adapter can advantageously deliver practically digital quality audio through a conventional analog
10 cassette player. Further, many of the severe disadvantages of conventional tape cassettes, such as stretching, breaking, loss of lubricant, scratching, becoming entangled in the player, and being erased by magnetic fields, are eliminated. Practically all automobiles are equipped with a cassette player as standard equipment at present.
15 If a driver desires a higher quality sound, the expense of adding a compact disc player is required, increasing the probability of damage to the automobile when this expensive equipment is stolen. With the present invention, CD quality audio is possible in an automobile, without the risk and expense of adding a CD player to the automobile.

20 As was mentioned above, an embodiment is contemplated for use with digital audio tape (DAT) devices. If used exclusively with such devices, both digital quality high fidelity recording to MMCs and playback therefrom is possible. In such an embodiment, transducer 7A and A/D-D/A 8A (Fig. 5) are designed to
25 accommodate the standard DAT interface, and the processor 9

programmed accordingly, as would be readily apparent to those skilled in the art.

It should be understood that the MMCs 5a may simply have memory circuitry thereon, or may also have a rudimentary state machine, micro-controller, or microprocessor thereon. Processor 9 is programmed to accommodate a variety of MMCs, e.g., those using Flash memory and those using other types of non-volatile memory. When equipped with an on-board processing capability, an MMC may also be referred to as a "smart-card."

10 The optional power connector 13 provides a means to provide additional power for operating the adapter, e.g., when recording an MMC FlashPROM or MMC ROM through the digital interface 12, from an external source.

Although the illustrated and described embodiment is for use with standard audio cassette recorders/players, the invention is not necessarily limited thereto. It is within the spirit of the invention to modify the disclosed embodiment for use in video cassette recording/playback, for example.

While the adapter according to the invention is designed to provide a means through which digital quality audio (or video) can be achieved with a conventional tape device, the inventors are in no way encouraging or advocating the violation of any copyrights of the artists involved in the creation of the audio (or video) works recorded and played-back therewith. It is contemplated that the adapter should be used in compliance with all laws pertaining to such rights. The

It will be apparent to one skilled in the art that the manner of making and using the claimed invention has been adequately disclosed in the above-written description of the preferred embodiments taken together with the drawings.

- 5 It will be understood that the above described preferred embodiments of the present invention are susceptible to various modifications, changes, and adaptations, and the same are intended to be comprehended within the meaning and range of equivalents of the appended claims.

What is claimed is:

- 1 1. An adapter for insertion into a tape recorder and/or
2 player device, comprising:
3 a housing having a shape and size permitting insertion and
4 engagement in the tape device;
5 an interface for receiving and/or transmitting signals with a
6 head of the tape device;
7 a processor, electrically connected with the interface, for
8 receiving the signals from the interface and/or providing the signals
9 to the interface; and
10 at least one socket, electrically connected to the processor, for
11 receiving a removable storage circuit device;
12 wherein the processor is capable of storing signals received
13 from the interface to a removable storage circuit device through the at
14 least one socket, and/or reading signals from a removable storage
15 circuit device through the at least one socket, when a removable
16 storage circuit device is inserted into the at least one socket.
- 1 2. The adapter according to claim 1, wherein the interface
2 comprises:
3 a magnetic transducer; and
4 a converter for converting between analog and digital signals.
- 1 3. The adapter according to claim 2, wherein the converter
2 comprises an analog-to-digital and a digital-to-analog converter.

1 4. The adapter according to claim 3, wherein the at least
2 one socket comprises a plurality of sockets.

1 5. The adapter according to claim 4, wherein the plurality
2 of sockets are accessible to removable storage circuit devices through
3 respective slots in the housing, provided on a peripheral edge of the
4 housing.

1 6. The adapter according to claim 5, wherein the housing is
2 rectangular, the plurality of sockets comprises six sockets, the
3 housing has six slots, one pair of slots is provided on each of three
4 edges of the housing, the transducer being provided at a fourth edge
5 of the housing.

1 7. The adapter according to claim 1, further comprising a
2 digital connector electrically connected to the processor, for coupling
3 an external source of digital data to the processor.

1 8. The adapter according to claim 1, further comprising at
2 least one battery compartment in the housing, for receiving at least
3 one battery therein, and electrical contacts in the at least one battery
4 housing for supplying electrical energy to at least the processor and
5 the interface.

1 9. The adapter according to claim 1, wherein the interface
2 comprises circuitry adapted to be compatible with a digital audio tape
3 (DAT) device.

1 10. The adapter according to claim 1, wherein the housing
2 includes spindle holes for receiving standard cassette device spindles,
3 and wherein the adapter further comprises at least one sensor,
4 connected to the processor, for sensing rotation, rotation direction,
5 and rotational speed of a respective spindle.

1 11. An adapter for insertion into a tape recorder and/or
2 player device, comprising:
3 a housing having a shape and size permitting insertion and
4 engagement in the tape device;
5 interface means for receiving and/or transmitting signals with a
6 head of the tape device;
7 processing means, electrically connected with the interface, for
8 receiving the signals from the interface and/or providing the signals
9 to the interface, and controlling the interface; and
10 at least one socket, electrically connected to the processing
11 means, for receiving a removable storage circuit device;
12 wherein the processing means is capable of storing signals
13 received from the interface means to a removable storage circuit
14 device through the at least one socket, and/or reading signals from a
15 removable storage circuit device through the at least one socket, when

16 a removable storage circuit device is inserted into the at least one
17 socket.

1 12. The adapter according to claim 1, wherein the removable
2 storage circuit comprises a multi-media card (MMC).

4 13. The adapter according to claim 12, wherein the multi-
5 media card (MMC) includes non-volatile memory.

14. The adapter according to claim 12, wherein the multi-media card (MMC) includes non-volatile flash memory.

10 15. The adapter according to claim 1, wherein the tape
11 device is an audio cassette tape recorder and/or player.

13 16. The adapter according to claim 15, wherein the tape
14 device is a digital audio tape (DAT) recorder and/or player.

16 17. The adapter according to claim 1, wherein the tape
17 device is a video cassette tape recorder and/or player.

18. The adapter according to claim 1, wherein the tape
device is a digital video tape recorder and/or player.

19. The adapter according to claim 11, wherein the
removable storage circuit comprises a multi-media card (MMC).

25 20. A method of providing high fidelity recording and/or
26 playback of audio and/or video, comprising utilizing the adapter
27 according to claim 1.

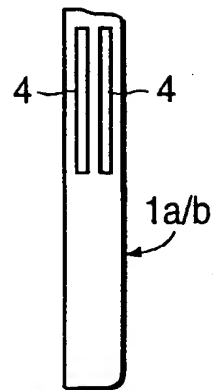
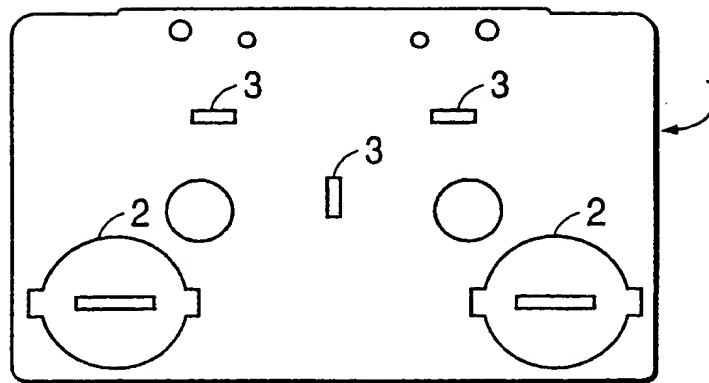
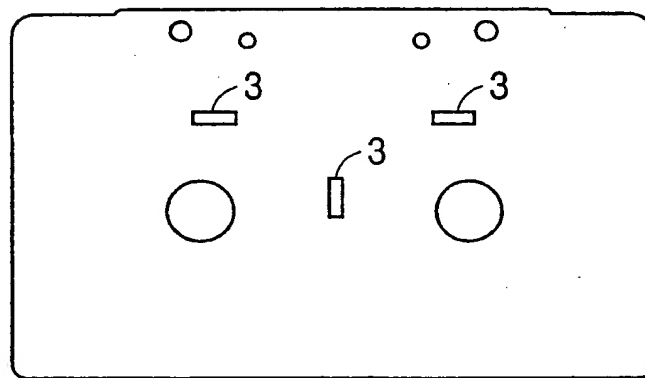
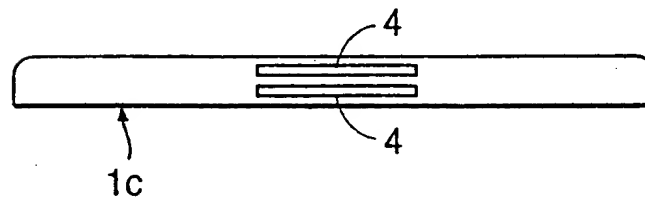
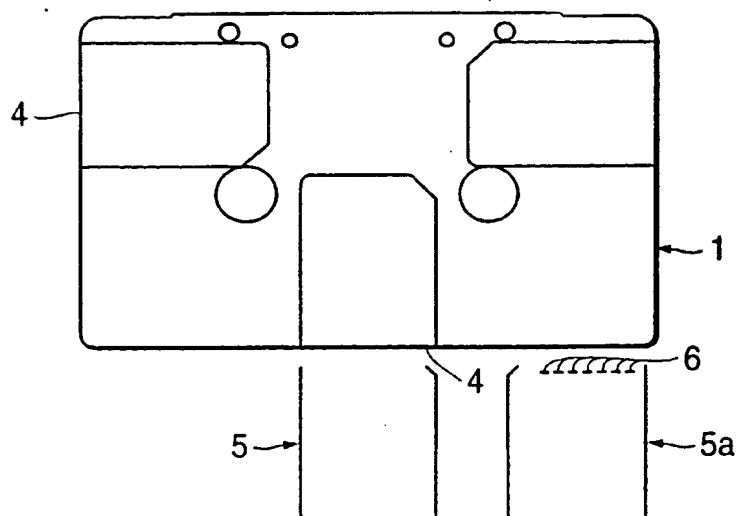
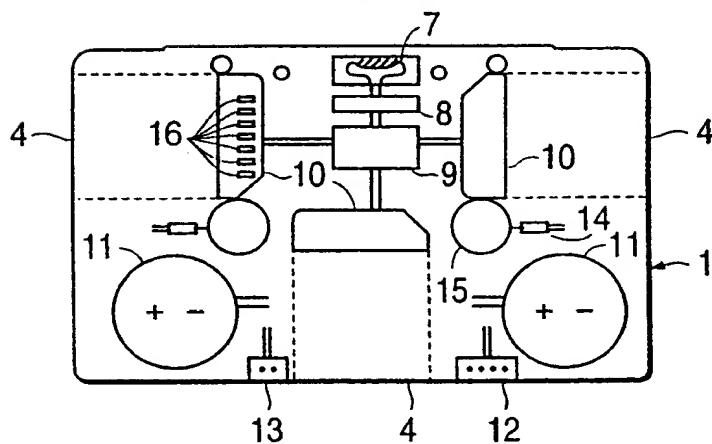
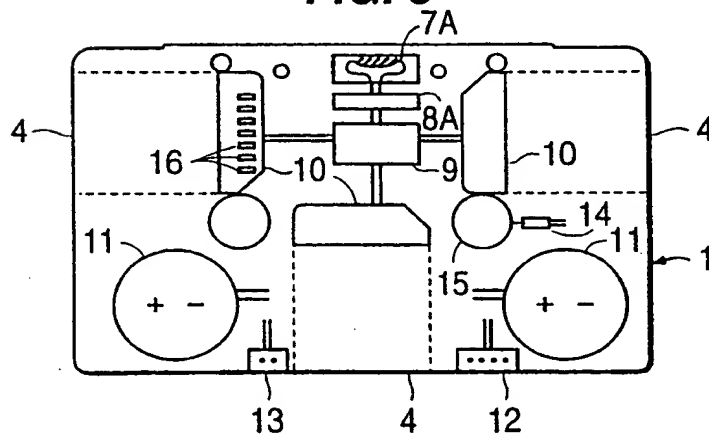
FIG. 1b**FIG. 1a****FIG. 2a****FIG. 2b**

FIG. 3**FIG. 4****FIG. 5**

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/00815

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) : G 06K 19/06

US CL : 235/493, 492, 451, 380, 375, 486; 902/26, 27

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 235/493, 492, 451, 380, 375, 486; 902/26, 27

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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Please See Extra Sheet.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,055,947 A (SATO) 08 October 1991 (08/10/91), see entire document	1-9 and 11-20
Y	US 5,584,043 A (BURKART) 10 December 1996 (10/12/96), see entire document	1-9 and 11-20
Y,P	US 5,734,781 A (CANTONE) 31 March 1998 (31/03/98), see entire document	10
Y	US 5,390,870 A (SAWADA ET AL) 21 February 1995 (21/02/95), see entire document	1-20
Y	US 5,457,590 A (BARRETT ET AL) 10 October 1995 (10/10/95), see entire document	1-20
Y	US 5,479,312 A (MASUDA ET AL) 26 December 1995 (26/12/95), see entire document	1-20

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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INTERNATIONAL SEARCH REPORT

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5,375,037 A (LE ROUX) 20 December 1994 (20/12/94), see entire document	1-20
Y,P	US 5,663,553 A (AUCSMITH) 02 September 1997 (02/09/97), see entire document	1-20
Y	JP 03-30007 B (TAKEGUCHI ET AL) 08 February 1991 (08/02/91), see the figures and the abstract	1-20
Y	US 5,479,312 A (MASUDA ET AL) 26 December 1995 (26/12/95), see entire document	1-20

Form PCT/ISA/210 (continuation of second sheet)(July 1992)*

INTERNATIONAL SEARCH REPORT

International application No.
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B. FIELDS SEARCHED

Electronic data bases consulted (Name of data base and where practicable terms used):

US PTO APS

search terms: cassette(p)(removable or detachable)(p)(memor### or storag? or stor?), (analog(3w)digital or digital(3w)analog)(2w)(signal#), adapater, (card or medium or electronic or ic or smart)(p)adapt?

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